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A Review of New Training Technology at the U.S. Army Signal School

William B. Johnson
CAE-Link Corporation

and

Michael G. Sanders
U.S. Army Research Institute

Field Unit at Fort Gordon, Georgia
Michael G. Sanders, Chief

Training Research Laboratory
Jack H. Hiller, Director

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EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

Research accomplished under contract for the Department of the Army

CAE-Link Corporation

Technical review by

Frank Moses
Mark A. Sabol

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The Signal School and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Fort Gordon Field Unit surveyed and assessed training technology both within and outside of the Signal School. Interviews with managers and instructional staff at the school were followed by training technology questionnaires completed by representatives of all of the school's training departments. The results showed that the majority of the Signal School's new training technology is delivered with interactive videodisc. Full scope simulators, procedural trainers, and computer controlled basic electricity/electronics test benches are also used. New training technology alternatives, not currently at the Signal School, were reviewed by ARI and a contractor team. The majority of systems reviewed used artificial intelligence techniques to deliver intelligent tutoring systems (ITS). Most of the ITS identified were in a transitional stage of development. Reviewers gave particular attention to systems likely to be compatible with Electronic Information Delivery System (EIDS), which is readily available in the Army training environment. During the final stage

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of research, ARI conducted a training technology workshop for Signal School management. The workshop reported the current status of and plans for future development and use of new technology training at the Signal School.

FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) performs research on skill acquisition and retention using emerging and training technologies to ensure that the most efficient and effective techniques are used in the training of Signal soldiers.

This project serves as a baseline to determine the extent of application of new technologies in the Signal School and at other sites teaching similar topics. The work described in this report is a part of a larger research program entitled Technologies for Communications and Electronics Skills Training. The results of this report were briefed to the Signal School Command Group on 2 November 1988, and also to the training departments, and serve as input to training plans and training development projects.

Additional initiatives at the ARI Fort Gordon Field Unit include the following: (1) development and evaluation of a generic training methodology for use at the Signal School, (2) intelligent tutoring system (ITS) for the Mobile Subscriber Equipment (MSE) large node operator, and (3) an ITS and Intelligent Decision Aid for the MSE manager.

A REVIEW OF NEW TRAINING TECHNOLOGY AT THE U.S. ARMY SIGNAL SCHOOL

EXECUTIVE SUMMARY

Requirement:

To document the current status of the application of educational technology to operator and technician training at the U.S. Army Signal School at Fort Gordon, Georgia. Since the Signal School has been an Army leader in the development of interactive videodisc (IVD), the research project identifies the level of use of IVD and other such training technology. The research also identifies candidate training applications for research related to intelligent tutoring systems.

Procedure:

The evaluation of the Signal School's training technology consisted of ARI interviews with managers and instructional staff at the school. The interviews were followed by training technology questionnaires completed by representatives of all of the school's training departments. In addition, the research team identified and reported on a variety of new training technologies that were not currently used at the Signal School.

Findings:

The interviews and questionnaires determined that over one million student hours of instruction are delivered with new training technology at the Signal School. The majority of this training uses interactive videodisc. The research also identified and reported 15 examples of new training technology for Signal School consideration.

Utilization of Findings:

The report is valuable in terms of demonstration of the methodology used for gathering and reporting current status and plans at one Army installation. Further, there is general information regarding new training technology and how to select appropriate candidates for such media. The report also contains specific information that characterizes training technology at the Signal School.

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Introduction

New training technology can be loosely defined as training requiring the use of computers. This definition is broad enough to include a wide gamut of instruction that includes the following kinds of training: computer-based instruction (CBI), interactive videodisc (IVD), computer-controlled simulators, computer-controlled real equipment, computer-based testing. Actually "new training technology," as defined here, is not really that new. Computer-based instruction has been around since the early-60s. CBI was an outgrowth of the programmed learning materials of the 50s. However, the mundane, unimaginative, slow, and often boring instruction that could be delivered with the older computer systems should hardly be classified as "new training technology."

New training technology capitalizes on the lessons learned during the past two decades of CBI research and development (R&D). That R&D has provided vastly improved hardware systems, software alternatives, and a "new training technology" instructional approach. Developers of new training technology recognize that the novelty can no longer substitute for efficient, effective, interesting, and motivating instruction that can be delivered with CBI. The expectations of students and reasonable demands of instructional personnel require that new training technology must be more than a trendy instructional approach. It must work! This project looked at such new training technology.

Background

The U.S. Army Signal School (School) is recognized as a leader in the production and use of IVD. Since 1982, the School has produced over 100 IVD programs. The Staff and Faculty Department has trained nearly 1,000 civilian and military personnel in the production of IVD training. While there are an abundance of IVD applications providing efficient and effective training at the School, the trainers and managers recognize that IVD is only one of many training technology alternatives.

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) established a field unit at Fort Gordon in 1987. The field unit has a mission to provide scientific technical advisory service to the School while also performing long-term applied research on skill acquisition and retention. This Training Technology Review (TTR) project is intended to serve the goals of both the School and ARI. For the School, the

TTR identifies current status of training technology at the School and outlines alternatives for the future. For ARI, the TTR identifies alternatives for continuing research in support of the Signal School training requirements.

Project Goals and Steps

The overall goal of the TTR was to identify the current status of new training technology in place at the School, compare it to other available technology, and outline a plan of research and development for the School. This final report documents the four distinct steps to the TTR. They included the following:

- Review Signal School Applications of New Training Technology
- Review and Report Applicable New Training Technology Outside the Signal School
- Conduct Signal School Management Review of Findings
- Prepare Final Report/Plan

New Training Technology At The Signal School

To assess new training technology, the team used a combination of interviews, questionnaires, and follow-up discussions. The results of that process are described.

The Signal School's Departments

The first goal was to identify the current status of new training technology at the School. A brief description of the School's structure is helpful to identify the dimensions or breadth or variety of training topics, needs and applications.

The School is divided into seven major training departments with support from various divisions of the Directorate of Training and Doctrine. The major departments are 1) Area Communications, 2) Electronic Maintenance, 3) Radio Telecommunications, 4) Specialized Electronics, 5) Transmission Systems, 6) Computer Science School, and 7) Non-Commissioned Officers Academy. There are many affiliated critical organizations at Fort Gordon such as the National Science Center for Communications and Electronics.

Initial Interviews

The information gathering began with a series of interviews with the School's top managers, including military and civilian administrators. These interviews were conducted with all the

organizations mentioned above. Approximately 35 people were briefed by a combination of contractor and ARI personnel during the initial thirteen meetings.

The goal of these interviews was to insure that the training technology review was addressing the most pertinent issues and contacting the most appropriate School personnel. In addition, the initial interviews were meant to insure that the training technology review was not a duplication of a previous effort. The type of information addressed during the interview includes types of training (e.g. simulators, IVD) used in addition to actual equipment, plans for the development of simulators and other training devices, and number of hours using alternative training strategies.

Initial Interview Results

The initial interviews confirmed that the training technology review was considered potentially valuable to the school. Department directors commented that they have wanted such a review but never had the personnel resources to complete one. Therefore, the research was not a duplication of other efforts.

The initial interviews showed that School personnel wanted to know more about the new training technology which may be available to them. They wanted to know what business, industry, and other services were doing for new training technology in electronics training as well as other environments. They also wanted to be sure that they were aware of the new training technology being used by other departments in the School.

Questionnaire for More Information

As a result of the initial interviews, a questionnaire was created. Its purpose was to gather additional, more specific, information regarding new training technology currently in place, or being planned, at the School. The questionnaire is included as Appendix A.

The questionnaires, with instructions, were mailed to all the School's training departments. Department directors were asked to distribute the questionnaires to appropriate personnel in their organizations. The questionnaires could be duplicated as needed. Respondents were given two weeks to return the questionnaires.

Questionnaire Response

Response to the questionnaire was overwhelming. Approximately 85 questionnaires were completed and returned. All of the training departments were represented among the responses.

Because the forms could be duplicated, responses exceeded the original number of questionnaires mailed. This response rate demonstrates the high level of School interest in training technology.

Training Technology Matrix

The original questionnaire data reflected 84 applications of new training technology that were in operation or being planned at the School. A matrix like the one contained in Appendix B was created and reviewed by each department director. Upon review, the matrix grew to 71 operational and 34 planned new training technology applications.

Definitions of Training Technologies

The training technology applications were divided into seven categories with the following definitions:

- Computer-Based Instruction (CBI): Instruction delivered by the computer. For this project, CBI is limited to instructional delivery where text and/or computer graphics are the primary interface to the student. For the matrix, this definition does not include instruction with intelligent tutoring provided by an artificial intelligence component nor does it include interactive videodisc or computer simulation.

- Computer-Based Testing (CBT): Testing delivered and scored by the computer.

- Intelligent Computer-Based Testing (ICBT): Testing delivered and scored by the computer. Using expert systems technology, ICBT permits the test to adapt to the student's knowledge level and/or provide prescriptive feedback based on test performance.

- Computer Simulation (CSIM): A type of computer-based instruction that presents the user with graphical representation of a system, thus permitting operation and/or diagnosis of the system.

- Computer-Controlled Simulation (CCSIM): Hardware system that is designed with the physical and functional characteristics of the real equipment but is under the control of a computer simulation.

- Computer-Controlled Real Equipment (CCRE): Real systems that have additional software added to provide training. This training is usually some form of simulation thus permitting the user to operate the equipment in a training environment. Training software contained in real equipment is also called embedded training.

o Real Equipment (RE): This category was included because many high technology systems are used for training. An example from the Signal Leadership Department is the laptop computers and various software packages, such as spreadsheets or word processing programs. The real equipment is the hardware and software that must be mastered as a part of the program of instruction. In the Specialized Electronics Department, avionics students use actual automated test equipment for training.

o Interactive Videodisc (IVD): A form of computer-based instruction where the primary information delivered to the student is audio and visual data from a computer-controlled videodisc. IVD provides traditional CBI as well as computer simulation. It can also be used for computer-based testing. IVD is the most prevalent form of new training technology at the Signal School.

Signal School Applications

The School reported that 1,068,419 student hours of training are delivered annually with some form of new training technology. On the following page, Figure 1 shows the breakout of total annual student hours trained with each technology.

Figure 2, page 7, shows the breakout between the operational training technology and the planned new training technology at the Signal School. As shown, the IVD column represents 55 (77%) of the operational systems and 25 (74%) of the systems being planned. From these two figures alone, it is obvious that IVD is the most common new training technology in place at the School. That is no surprise, since the School has been a recognized leader in IVD applications over the past five years.

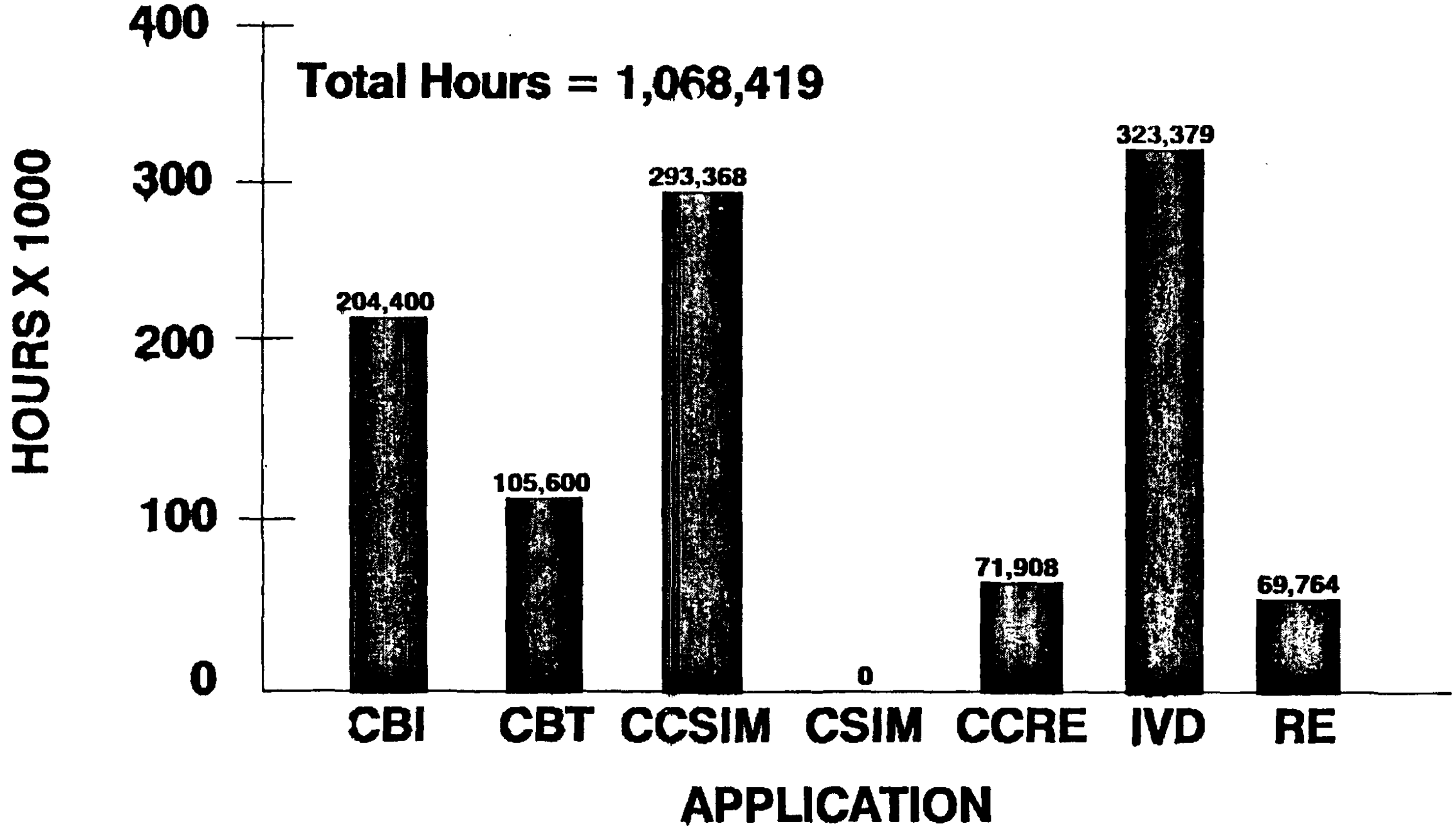

Figure 1. Annual hours of student use for each technology

CBI - Computer-Based Instructions
CBT - Computer-Based Testing
CCSIM - Computer-Controlled Simulation
CSIM - Computer Simulation
CCRE - Computer-Controlled Real Equipment
RE - Real Equipment
IVD - Interactive Videodisc

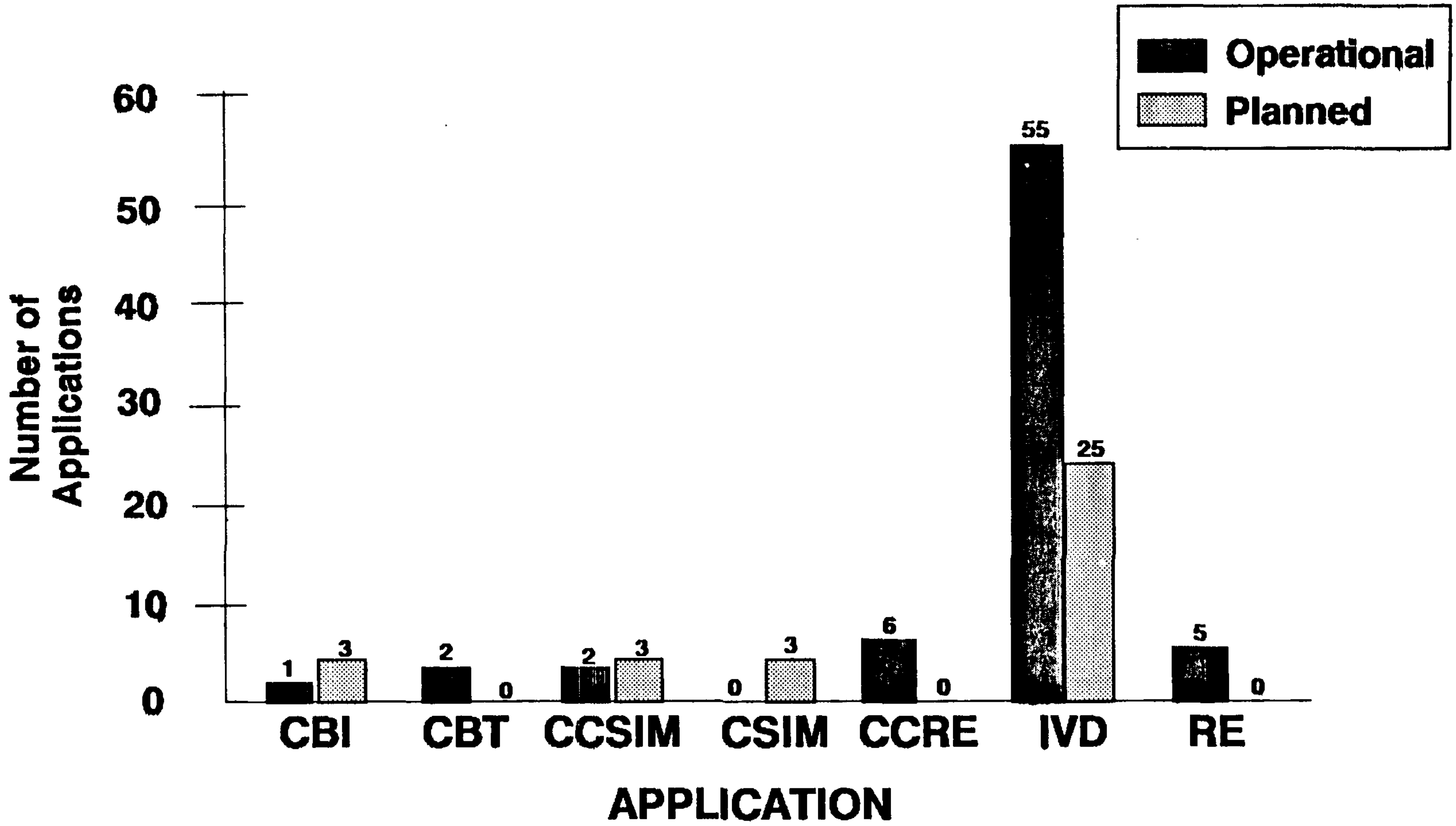

Figure 2. Operational vs. planned training technology

CBI - Computer-Based Instructions
CBT - Computer-Based Testing
CCSIM - Computer-Controlled Simulation
CSIM - Computer Simulation
CCRE - Computer-Controlled Real Equipment
RE - Real Equipment
IVD - Interactive Videodisc

Signal School Plans

Referring back to Figure 1, it can be seen that a large percentage (74%) of the planned training technology will be IVD. Because the School has the know-how to create IVD efficiently, it is reasonable to plan accordingly. Since the Army has committed to the Electronic Information Delivery System (EIDS), the plans should include continuing IVD development and use. The review suggests ways that IVD instructional design can capitalize on approaches such as the use of expert systems in the training software.

Hardware Systems Used

The majority of the new training technology is IVD (approximately 95% developed in house), and the most common hardware identified was the "Interim EIDS". Before the EIDS systems were available, the IVDs were developed and delivered on Sony microcomputers that the School called "Interim EIDS." Therefore, the majority of the School's IVDs are on the Sony Systems. The IVDs now in development are being completed with the EIDS hardware and development courseware.

Strengths and Weaknesses

The questionnaire asked for comments regarding the strengths and weaknesses of the various training technology. The actual comments are listed in Appendix C, they are summarized below.

o Strengths. The IVD used at the Signal School is designed as equipment simulation. Therefore, an important strength is that IVD permits standardized, individualized practice at equipment operation and troubleshooting in a risk-free environment. Another commonly reported strength is that IVD lowers the burden on real equipment. It also permits the instructor time to spend with those students most in need of assistance. Another set of advantages referred to the cost effectiveness of IVD when the programs can be broadly distributed and used on the Army-wide EIDS equipment.

o Weaknesses. Reported strengths outnumbered weaknesses. However, the most common weakness reported related to the IVD development time and associated manpower/equipment costs. Respondents identified the need for additional development staff and more computer systems for instruction delivery.

Some of the weaknesses cited showed that School personnel recognize the need to improve the instructional approach to IVD. This would include more sophisticated branching and, as one suggested, the integration of expert systems into the IVD delivery system.

One weakness that may need immediate attention is problems with the software that converts from the Sony computer to EIDS. A respondent commented that the current conversion program requires each touchpoint to be checked. Because each IVD program has thousands of touch points and there are over 65 programs that must be converted, the conversion software must be modified.

General Comments

The last response on the questionnaire invited "general comments about new training technology." Introspective and important responses regarding new training technology at the School are summarized below.

o There was a comment regarding what might be considered the double-edged sword of reduced funds. Reduction in funds for training equipment and instructional staff suggests that there will be a greater need for new training technology. However, as funding is reduced, one of the first cuts is in development of new technology.

o Another comment referred to the increasing Army emphasis on standardization. The respondent cautioned that there will always be the need for locally prepared instruction to cater to specific course requirements. The School has that capability and does not want to lose it.

o One respondent noted that the School must develop an overall plan, or strategy, to insure that it remains abreast of new technology training. On the same note, there was a concern that the School develop a way to identify when new technology training is appropriate. That respondent cautioned that CBI, IVD, etc. may not always be the most appropriate instructional solution.

o One of the responses was quite profound, a fitting final comment for this section: "As computers become more compact and have more capabilities, we find them in more places in our lives. They are becoming natural extensions of ourselves and future generations will expect to find computers at home, at school, and at work." Based on the interviews and the questionnaire responses, the comment reflects the pro-technology attitude at the School.

Training Technology Outside The Signal School

While the major concentration of this study was on training technology at the School, it was important to make some determination about the new training technology outside of the School. This included the training used by the other services and the training technology emerging from government, industry, and university laboratories. With the time and resources

available to the project, most of the information was collected by review of current technical reports, journals, and conference proceedings. Extensive telephone interviews insured that the information was as current as possible.

Training Technology Fact Sheets

The initial interviews at the School revealed that personnel had considerable levels of expertise regarding training technology. However, everyone expressed interest in a set of forms that would review new training technology which might be applicable to the School. It was important that the systems be compared across the same dimensions. School personnel did not want a list of references or an annotated bibliography. Instead, they wanted a standardized review that answered the questions of interest to the School and to the ARI Field Unit. Thus, the Training Technology Fact Sheets (TTFS) emerged and evolved through discussions with School Management and Staff.

Appendix D contains the set of fifteen TTFSs that emerged from this initial review effort. The systems reviewed for the TTFS were selected for a number of reasons. For the most part, the technologies reviewed had demonstrated applicability to an electronics training environment. Many of the systems contained an element of artificial intelligence to provide intelligent tutoring. Some of the systems were reviewed at the specific request of School personnel. While the set of fifteen by no means is a complete set of all relevant new training technology, it is representative of the state of the art. A larger study may have created a higher number of fact sheets, although the overall representation would not be different.

New Training Technology in Other Services

Several military and training R&D activities were contacted in order to determine the level of use of new training technology outside the School. We talked with the U.S. Air Force Training Command Headquarters at Randolph AFB, Texas; the U.S. Navy Education and Training Program Management Support Activities in Pensacola, Florida; the new training technology research and development personnel at the Air Force Human Resources Laboratory (HRL) in Brooks AFB, Texas; the Navy Personnel Research and Development Center (NPRDC), San Diego, California; and the Army Research Institute (ARI) Training Research laboratory in Alexandria, Virginia.

In the applied basic electronics training domain, we conducted telephone interviews with personnel from Army training personnel at Redstone Arsenal, Huntsville, Alabama; and Navy training personnel at San Diego, California and Memphis, Tennessee.

Our questions outside the Army Signal School were limited to new training technology in the electronics domain, with specific emphasis on basic electricity/electronics. The resources available to this survey effort made it infeasible to identify all new technology training for all electronic devices. While we did accomplish that at the School, we did not attempt to do so across the Services and industry.

At the outset of each telephone conversation, the interviewee was told about the ARI training technology review at Fort Gordon. The military respondents all knew about Fort Gordon and implied that the Army Signal School had more new training technology than any of the other services. The Air Force and the Navy both inquired about the availability of IVD lessons from Fort Gordon.

A respondent from Air Training Command said that there were numerous applications of simulators and specific training devices scattered throughout the Air Force training community. However, there was no universal CBI or IVD that is used for general basic electronics training. The Air Force currently is seeking advice from the Army with respect to IVD for basic electronics training.

The Navy also expressed interest in the many IVD programs at the School. According to the respondent, the Navy has gone through a major transition with respect to new training technology for their Basic Electricity and Electronics (BEE) School. Through the early to mid-80s, the BEE schools throughout the Navy were self-paced and controlled by computer managed instruction (CMI). Perceived fleet performance deficiencies of electronic technicians caused the Navy to cease applications-oriented development and implementation on all computer-based training for electronic fundamentals. While the Navy did not abandon training technology research, it halted new training technology in the BEE schools. The pendulum is now beginning to swing back for Navy electronics training. The Navy has recently established a Model School Project for the Electrician Mate at reat Lakes Naval Training Center. The Model School will serve as a testbed for new training technology. This new program is not expected to be fully operational until 1990.

The Navy, like the Air Force, has a variety of new technology training for specific Naval Systems. An interactive videodisc for helicopter maintenance training is one example. Other such examples include IVD, CBI, full-scope simulation, and combinations thereof. None, however, is dedicated to basic electronics. The time and resources of this training technology review were not dedicated to further exploration of Naval Training.

The overall conclusion generated by numerous telephone conversations with personnel from the other services is that Fort Gordon is in a leadership position with respect to new

training technology for electronics topics. The other services use the Army Signal School as an example of how IVD can be developed locally and integrated into the curriculum.

Basic Electronics Training Technology in Industry

In the commercial sector, responses were sought from a few industries that employ substantial numbers of electronic technicians. The sample included AT&T in Atlanta, Georgia, and Cincinnati, Ohio; IBM Corporation in Atlanta, Georgia; Duke Electric Power Company in Charlotte, North Carolina; Pennsylvania Power and Light Company in Berwick, Pennsylvania; and the Boeing Commercial Airplane Company in Seattle, Washington. Consistent response showed that:

o industry attempts to hire technicians with certain prerequisite knowledge and skills obtained in technical schools and/or prior military experience,

o currently, there are enough job applicants with such experience and training to meet the needs of industry, and

o demographic data indicate that industry will soon have to provide training to ensure sufficient personnel for the growing number of high technology jobs (Business Week, 1988).

In addition, most of the basic electronic courses taught in industry use traditional classroom techniques. While off-the-shelf computer-based training packages are available, such programs are often too general to meet the specialized needs of specific industries. Therefore, industry must invest the time to develop custom computer-based courseware or resort to traditional instructional techniques.

Companies such as IBM use CBI and IVD for employee training. Their programs are made for training all field service technicians on such aspects as projecting the IBM image, safety in electronics repair, and efficient use of time and spare parts. In the electric power industry, CBI and IVD are used most often for the high volume training applications such as general employee training and health physics.

AT&T has a group that has dedicated responsibility to research and development of new technology alternatives for training. That group continually increases the use of new training technology to include CBI and the use of teleconferencing for elected instruction. However, they do not use as much new technology training as the School.

The Boeing Company reported that much of their customer service training has an orientation toward specific aircraft systems. Users of their CBI or IVD are likely to be technicians

with job experience and/or formal training in aircraft electronics. Based on a few telephone conversations, it was not possible to survey new technology training across the numerous Boeing companies. However, we did not learn of any new training technology used at Boeing that is not already used at the School.

In summary, the industry survey revealed courseware and approaches that already are used at the School. Because the Army does so much training, it is ahead of industry in regard to use of new technology training research and utilization.

Planning For The Future

The preceeding discussion could leave the School in a mode of complacency. If the School is in a leadership position for new training technology in the basic electronics domain, then it could wait for the other services or industry to catch up. If the School is truly ahead of the other services, then perhaps it is close enough to the cutting edge. Of course, the School response must be aimed at moving ahead to capitalize on the new instructional technology that can enhance current IVD and CBI. What is the new technology and what steps should the School take to benefit from it? This section will attempt to answer these questions.

The New Technology

New training technology can be defined along at least two dimensions. One dimension is hardware and the other is the software-based pedagogical approach. The hardware approach would emphasize such technology as Compact Disc Read-Only Memory (CD-ROM), Write-once Optical Recording Media (WORM), high resolution color graphics, parallel processing (very powerful) micro-computers, etc. The new technology software-based pedagogy has much "catching up" to do in order to match the advances in hardware technology. Therefore, this section addresses software approaches for current technology rather than the evolution in hardware devices.

The Goal of New Training Technology

The goal of new training technology should be to provide effective instruction in an efficient manner. Effective instruction means the delivery of information such that there is a positive change in the student's post-training knowledge, skill, and/or attitude. Succinctly, the student must learn from the instruction. Efficiency can include such things as the rate (i.e., time) at which the student learns and the cost to develop and deliver the instruction. New technology should provide better and more training in the same, or less, time. This is

possible by increasing student practice time with simulation, efficiently using student time while queued waiting for real equipment, and insuring that the instructor is available to students most in need of remediation.

New training technology should not only enhance effectiveness and efficiency, it should also have a positive effect on the student's motivation. Early CBI was often mundane; in fact, it was boring. It provided little more than drill and practice or tutorials with limited branching. While it was considered to be "individualized," everyone, in reality, received the same instruction in the same linear order. Interactive videodisc provided motion and audio but, in many cases, it also was mundane. At best it was slightly better than using a book with nice pictures. Students accepted the early CBI, perhaps because of the novelty of the computer and the option to proceed at their own learning pace. That is not enough for today's students. User expectations of CBI and IVD have increased, and new training technology must respond to those expectations.

Intelligent Tutoring - The New Training Technology

New training technology must provide instruction that combines the individualized, self-paced benefits of an interactive computer with the knowledge, understanding, and explanation capabilities of a competent human instructor.

The new training technology must know how individual students learn best, how they should be motivated, when to interrupt them, the kind of errors to which they are prone, their prerequisite knowledge and experience, and a variety of such information that is often used by a human instructor. The new training technology must be able to create and maintain a dynamic model of each student and then structure subsequent instruction accordingly.

In order for the new training technology to deliver instruction using a "model" of the student, it must have its own model of an instructor. If the instructor is to be able to offer explanation, the new training technology must have knowledge about the instructional domain.

The preceding paragraphs have introduced the primary components of an Intelligent Tutoring System (ITS). Such systems have been described elsewhere (Polson & Richardson, 1988; Psotka, Massey, & Mutter, 1988; and Wenger, 1987). This report will not elaborate on those references.

New Technology Workshop

This project phase culminated with a full day workshop at the School. The workshop agenda and list of speakers is included as Appendix E. The meeting was attended by approximately 70 people representing all of the departments of the School.

The status of new training technology at the School was reported and discussed. A major focus of the meeting was the topic of Intelligent Tutoring Systems. Various ITSs were described and/or demonstrated (see agenda). The workshop ended with discussions regarding the combination of IVD and ITS as the School's next major step toward new training technology application.

Conclusions

The School is currently a leader in the development and use of IVD. This fact demonstrates that the School is committed to new training technology. It also shows that the School has an organization that can work together to conceptualize, develop, and implement such instruction across a variety of instructional applications. The School already has a competent cadre of educational technologists. Such personnel have the ideal qualifications to develop ITS (Johnson, 1988b). The increasing number of EIDS terminals insures that the hardware technology is also in place. This section presents ideas that capitalize on the installed training technology at the School.

Signal School Strategy

One of the questionnaire respondents suggested, and this report concurs, that the School must develop or reassess a strategic plan regarding new training technology. Such a plan would set the overall organizational goals. The operational plans must be derived from these goals.

This report is not meant to be the strategic plan; however, there are a few alternative high-level inputs to such a plan. First, the School must continue to be a military leader in the production and use of IVD. Secondly, the School must build upon IVD success to capitalize on emerging training technology. Third, the School must respond to the current funding environment so that new training technology will be an asset rather than a burden. Each of these strategic goals will have detailed operational plans as suggested in the following sections.

Continued IVD Leadership

In order to continue as a leader in IVD, the School must identify equipment systems and courses that would benefit from the IVD instructional approach. This would include new hardware systems coming into the inventory as well as the older systems that have not benefitted from the IVD approach.

An important task facing the School is the conversion of the IVD from the interim EIDS to the new EIDS. Perhaps all of the existing programs are not worthy of the conversion. A plan must be developed to select the appropriate IVDs for conversion to the new EIDS.

The IVD success story at the School has received excellent marketing during the 80s. School personnel have participated in conferences, presented papers, and demonstrated IVD competence throughout the Army, the other services, industry, and schools. This level of national and international participation and leadership should be encouraged.

Capitalize on Emerging Training Technology

The School has an installed base of microcomputer training delivery systems in the form of EIDS. As the interim EIDS are converted to the new EIDS, this is the time to integrate expert systems training technology, or ITSs, into the instructional design.

There are a number of operational steps that could lead to the accomplishment of this strategic goal. The first step would be the selection of one of the successful interim EIDS IVDs that will have a high payoff when converted to an EIDS-IVD ITS. High payoff applications for ITS are described by Johnson (1988b). The characteristics of candidate application areas include:

- o high flow of students,
- o expensive real equipment,
- o unavailable real equipment,
- o unsafe to use real equipment,
- o necessary development of critical knowledge and skills,
- o training which may be conducted at remote sites,
- o low availability of instructors,
- o high public visibility, and
- o the need for high volume of recurrent training.

For Signal School considerations, the list would also include:

o IVD needing conversion to EIDS,
o IVD lesson has been and will continue to be widely used, o IVD lesson would be excellent for marketing,
o dDpartment has a large installed base of EIDS and other microcomputers, and
o Department has personnel willing to participate in ITS/IVD development.

Once the IVD is identified using the above criteria and other information from the School, a team of personnel must review the existing lessonware. The IVD should be evaluated to determine how the existing database can be integrated into the component parts of an ITS. As each decision is made, the development team must consider the implications for other IVD conversions that are likely to occur.

Before embarking on a major software development effort, the School should create a detailed list of specifications for their proposed IVD/ITS. The specifications should clearly outline what the IVD/ITS would be able to do. The specifications should be created with cognizance of the School's installed base of EIDS systems. The proposed IVD/ITS must operate in the EIDS environment. That is a reasonable goal (Johnson, 1988a, in press). ITSs can be built on EIDS.

Once the specifications are written and reviewed by School management and staff, a prototype should be built. The prototype would not be a complete IVD/ITS, but it would contain and demonstrate the key characteristics of the user interface. During prototype development, it can be determined how the IVD and ITS software would communicate and how the IVD database can be used to build the rules so necessary to the various experts within the ITS. The completed prototype could be used to show the School what the IVD/ITS would offer upon completion.

Once the prototype is reviewed, a completed system should be developed based on the finalized specifications. During development of the first system, the team should build or purchase software tools to simplify subsequent IVD/ITS construction. Therefore, subsequent ITS programs could be developed by School personnel.

Continue Expert System Work

The Electronics Maintenance Department has already used an existing expert system shell to develop and demonstrate intelligent computer-based testing program. Resources should be

allocated to complete that effort. It is a good example of the use of an expert system shell to build courseware for instruction. A very important consideration is that it is an in-house development that can be continued easily at the School.

Training Technology - An Asset or A Burden

New Technology Training is expensive! The expense is in the development staff time, either that of in-house or contractor personnel. The School must develop a method to accurately estimate the cost of developing and delivering the new training technology. The matrix in Appendix B and Figure 2 shows that the current IVDs are used heavily by the various departments. This level of utilization can justify a substantive investment in new training technology development. While the immediate personnel or dollar investment may appear to be a burden, the utilization figures show clearly that new training technology is an asset.

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Appendix A

Questionnaire

DEPARTMENT OF THE ARMY
US ARMY RESEARCH INSTITUTE
FORT GORDON FIELD UNIT
BUILDING 10507
FORT GORDON, GEORGIA 30905-5000

REPLY TO
ATTENTION OF

TO: Managers and Instructors of the Signal School

FROM: Dr. Michael Sanders
Army Research Institute

RE: Training Technology Review Forms

Within the past few weeks, Dr. William B. Johnson of Search Technology, Inc. in Atlanta and I visited with you to describe our plans to assess "new technology" training at the Signal School. We defined new technology to include such training techniques as computer-based instruction, interactive video disc, computer controlled trainers, training software embedded in prime equipment, and other such examples. The attached form will permit us to tally the new technology training in place, or planned, at Fort Gordon.

Please distribute this form, a completed example form, and a copy of this letter to your department personnel responsible for one or more of the new training technologies in your department. Use one form for each training technology application in your department. For example, if you have 5 IVD applications, then use 5 forms. Include training technology used for students or for staff enrichment.

As you know, we are on a very tight schedule. Therefore, please return all forms to me no later than 9 September 1988. Information returned by that date will be included in the final report.

Thank you, once again, for your willingness to help us with this training technology review. If you have any questions, call me at 791-5523 or Bill Johnson at (404) 441-1457.

ARMY RESEARCH INSTITUTE
ATTN: PERI-ICD (BUILDING 41203)
FORT GORDON, GEOGIA 30905-5000

TRAINING TECHNOLOGY REVIEW FORM

INSTRUCTIONS: Use one form for each new technology training application.
This form may be duplicated.
Please return to ARI by **September 9, 1988.**

DATE: ________________ **Form Completed By:** ______________________

Phone: ______________________

Course for which training is used: ______________________________________

Equipment, system, network, or knowledge/skill for which training is provided: _______

____.

Type of training technology (*Check One*)

- ☐ Computer-Based Instruction
- ☐ Interactive Video
- ☐ Computer Controlled Real Equipment
- ☐ Full Scope Simulator
- ☐ Other (*Specify*) ______________________________________

Name of training technology ______________________________________
(Examples: Computer-controlled NIDA 130, The Typing Tutor, EIDS O-Scope Trainer)

Developed By:

Contractor (*Name*) ______________________________________

Signal School (*Name*) ______________________________________

How long has this training technology been in place? _________ Months
How many students use it per week? _________ Students
How many students use the training system each year? _________ Students/year
How many total hours (over the course) for each student? _________ Hrs/student

How long will this technology and its database be able to provide current instruction before it must undergo major revision? Who will do the revisions?

What computer system is used for this technology?

What are the plans for future development of this training technology?

Strengths of the technology:

Weaknesses of the technology:

Will this system transport to the EIDS environment?

☐ Yes ☐ No ☐ Do Not Know(*Comment*)

<u>**Questions Not Specific To One Application**</u>

List equipment systems or courses that, in your opinion, are good candidates for new training technology. Why?

What are your plans to develop additional training technology? What are the obstacles to these plans?

List training technologies that ARI should review. (Provide system name and contact if possible.)

General comments about new training technology.(*Attach additional pages if necessary*)

Appendix B

Matrix of School Technologies

SUMMARY OF TRAINING TECHNOLOGY AT THE SIGNAL SCHOOL

ARMY RESEARCH INSTITUTE TRAINING TECHNOLOGY REVIEW REPORT

William B. Johnson
November 1988

Dept	MOS	Course/Equipment	Train Tech	Operating/ Planned	Months In Place	Students Per Year	Hours Per Year	EIDS Y/N	Planned (Year)	Major Revision
RTD		Single Channel Radio Ops. - FM	IVD	OP	6	3,750	37,500			1993
RTD		Ops/Troubleshoot 5KWGEN	IVD	OP	6	3,750	37,500			1993
RTD		Ops/Install 5KWGEN	IVD	OP	6	3,750	37,500			1993
RTD		Operate 5KWGEN	IVD	OP	6	3,750	37,500			1993
RTD		Pos. Loc. Report Sys.	CCSIM	PL						
RTD		Single Channel Objective Terminal	IVD	PL				Y		
RTD		Pos. Loc. Report Sys.	IVD	PL				Y		
RTD	72E	Telecom Cen. Spec. FM on Terminal Telegraph - AN/TSC-58	IVD	OP	36	1,840	1,840	Y		
RTD	72E	Installation of Terminal Telegraph - AN/TSC-58	IVD	OP	36	1,840	1,840	Y		
RTD	72E	Operation of Terminal Telegraph - AN/TSC-58	IVD	OP	36	1,840	3,680	Y		
RTD	72E	Troubleshoot AN/TSC-58	IVD	OP	36	1,840	1,840	Y		
RTD	72E	Typing Tutor	CBI	OP	1	2,800	204,400			
RTD	72G	Processing Incoming and Outgoing Messages in Magnetic Tape	IVD	OP	24	500	375	Y		
RTD	72G	Processing Incoming and Outgoing Messages in Paper Tape	IVD	OP	24	500	375	Y		
RTD	72G	Processing Incoming and Outgoing Messages in Punched Cards	IVD	OP	24	500	375	Y		
RTD	72G	Prepare Header and EOT Cards	IVD	OP	24	500	375	Y		
RTD	72G	Prepare MART for Operation	IVD	OP	24	500	500	Y		
RTD	72G	Operate MART	IVD	OP	24	500	500	Y		
RTD	72G	Prepare MATE for Operation	IVD	OP	24	500	500	Y		
RTD	72G	Perform Initialization of MATE	IVD	OP	24	500	500	Y		
RTD	72G	Operate MATE	IVD	OP	24	500	500	Y		
TSD	31Q10	Tac Satellite Terminal	IVD	OP	1	600	4,800	Y		1992
TSD	31Q10	Tropo Scatter Radio - Part 1	IVD	OP	24	600	9,600	Y		1994
TSD	31Q10	Tropo Scatter Radio - Part 2	IVD	OP	24	600	9,600	Y		1994
TSD	31Q10	Tropo Scatter Radio - Part 3	IVD	OP	24	600	2,400	Y		1994
TSD	31Q10	Tropo Scatter Radio - Part 4	IVD	OP	24	600	2,400	Y		1994
TSD	31L10	Install TA-341 ()/TT	IVD	PL				Y	1989	
TSD	31L10	Install Telephone Test Set	IVD	PL					1989	
TSD	31M10	Install Antenna AN/GRC-103	IVD	OP	24	2,303	6,909	Y		
TSD	31M10	Multichannel System T-Shoot AN/TRC 145	IVD	OP	24	2,303	27,636	Y		
TSD	31M10	Install Operator AN/TR C117	IVD	OP	24	2,303	9,212	Y		
TSD	31M10	Install Operate AN/TRC-145 & AN/TRC 113	IVD	OP	24	2,303	9,212	Y		
TSD	31M10	Install Operator Generator Sets	IVD	OP	24	2,303	9,212	Y		
TSD	31M10	Install Antenna AB-577	IVD	OP	24	2,303	9,212	Y		
TSD	31M	A TACS Simulation (REES)	CCSIM	OP	24	3,496	290,168	N		

Dept.	MOS	Course/Equipment	Train Tech	Operating/ Planned	Months In Place	Students Per Year	Hours Per Year	EIDS Y/N	Planned (Year)	Major Revision
EMD	29Y10	Ground Mobile Forces Controller AN/FSC-124	CCRE	OP	24	48	13,440	N		
EMD	29Y10	Satellite Terminal AN/GSL-52	CCRE	OP	24	160	6,400	N		
EMD	29Y10	Satellite Payload Controller	CCSIM	OP	24	80	3,200	N		
EMD	29Y10	AN/USC-28 Comm Set	CCRE	OP	72	300	15,000	N		
EMD	29Y10	SKIL-SatCom Principles	ICBT	OP	6	250	12,500	Y		
EMD	29Y10	Troubleshooting the MD1002	IVD	PL	1	370	6,000	Y		
EMD	31CV9	Install/Operate AN/MSC-64	IVD	PL		400	2,400	Y	1991	
EMD	31CV9	Install/Operate AN/TRC-179	IVD	PL		400	2,400	Y	1991	
EMD	31CV9	Troubleshoot AN/MSC-64 @ Unit Level	IVD	PL		400	2,400	Y	1991	
EMD	31CV9	Troubleshoot AN/TRC-179 @ Unit Level	IVD	PL		400	2,400	Y	1991	
EMD	101-FXX	Install/Operate AN/TSC-124	CSIM	PL		200	3,600	Y	1991	
EMD	29E and									
	101-FXX	Perform Unit Level Maintenance on AN/TSC-124	CSIM	PL		750	11,900		1990	
EMD	101-FXX	Operate AN/TSC-124 UCID	IVD	PL		200	2,800	Y	1990	
SLD		Applications Software	RE	OP	24	600	30,000	N		
SLD		TACCOMSIM	CSIM	PL		1,400			1993	
SLD		Unil Level Logistics System	CBI	PL		169			1989	
SLD		Senior Warrent Officer Training	CBI	PL		165				
NSC		Various Video Disc Applications	IVD	OP				Y		
SED		AHIP Avionics Repair Course	RE	OP	24	25	3,400	N		
SED	35K10	Avionics Mechanics CH47D AFCS	IVD	OP	60	289	13,872	N		
SED	35K	OH-58D System Trainer	IVD	OP	24	44	5,984	N		
SED	35K10	UH-60A Command Information System	IVD	OP	1	289	5,202	N		
SED		BET NIDA130C Training System	CCRE	OP	0	150	42,000	N	1988	
SED		BET Test Equipment IVD	IVD	PL	0	4,200	25,200	Y	1989	
SED		BET DC Funding IVD	IVD	PL	0	4,200	75,600	Y	1989	
SED		BET AC Funding IVD	IVD	PL	0	4,200	126,000	Y	1989	
SED		160-F21 PM on TSEC/KG-84	IVD	OP	24	300	800	N		
SED	39B	AN-MSM-105 Operation and Maintenance	CCSIM	PL		100	20,000	N	1989	
CSS	71D10	Mainframė Console OPS: MVS OP System	CCSIM	OP	14	400	1,200	Y		
CSS		LISP Tutor for Evaluation	CBI	PL	0			N	1989	
CSS	74F10	Automated Evaluation of StudentCOBOL Programs	CBT	OP	48	380	93,100	N		

Dept	MOS	Course/Equipment	Train Tech	Operating/ Planned	Months In Place	Students Per Year	Hours Per Year	EIDS Y/N	Planned (Year)	Major Revision
ACD	36M	AutoTEL Central Office AN/TTC-41(v)	IVD	PL	0	580	4,640	Y	1989	
ACD	36M	Telephone Switchboard SB-3614A	IVD	PL	0	580	4,640	Y	1989	
ACD	36M	Generator Set 10KW	IVD	PL	0	580	2,320	Y	1989	
ACD	36M	Term Control Dev. C-11767/TTC-41(v)	IVD	PL	0	580	2,320	Y	1989	
ACD	31K	SINCGARS-ICOM Simulation	IVD	PL	0	3,300	26,400	Y	1992	
ACD	39T	Troubleshoot and Repair LOGMARS	IVD	PL	0	550	8,250	Y		
ACD	39T	Troubleshoot and Repair AN/GYK-33	IVD	PL	0	550	5,500	Y		
ACD	29J	Troubleshoot and Repair AN/TSC-58	IVD	PL	0	550	10,450	Y		
ACD	29J	Troubleshoot and Repair AN/GRC-142	IVD	PL	0	550	9,350	Y		
ACD	29J	Troubleshoot and Repair AN/UXC-7	IVD	PL	0	550	14,850	Y		
ACD	29J	Troubleshoot and Repair AN/UGC-74	IVD	PL	0	550	37,400	Y		
ACD	39T	Troubleshoot and Repair TACCS Data Comm Equip.	IVD	PL	0	550	25,850	Y		
ACD	36L10	22 Lessons Related to Operation and Maintenance of AN/TYC-39 22	IVD	OP	6-36	188	33,088	Y		
NCO	CMF-29	Comm-Elec Maintenance ANOC TYQ-33 TACCS	CCRE	OP	12	351	14,040			
NCO	CMF-29	Comm Elec Maintenance ANOC Zenith Laptop Comp. Lit.	RE	OP	18	351	14,040	Y		
NCO	CMF-31	Signal Ops. ANOC Zenith Laptop Comp. Lit.	RE	OP	18	523	20,920	Y		
NCO	CMF-31	Signal Ops. ANOC Grid Computer with SB3614	RE	OP	4	351	1,404	N		
NCO	CMF-31	Signal Ops. ANOC TYQ-33 TACS	CCRE	OP	12	523	18,828			

Legend

OP - Operating System
PL - Planned System
CBT - Computer-Based Testing
IVD - Interactive Videodisc
CCRE - Computer Controlled Real Equipment
CBI - Computer-Based Instruction
RE - Real Equipment
CSIM - Computer Simulation
CCSIM - Computet Controlled Simulatio
ICBT - Intelligent Computer-Based Te

Appendix C

Strengths and Weaknesses

Questionnaire Responses Regarding

Strengths and Weakness of New Training Technology*

Strengths

Interactivity
Time Saving
Increase PE without more equipment or instructions
Allows instructors to remediate students
Permits practice (3)
Motion and still frame capability
Individualized (3)
Unlimited practice in hazard-free environment
Good for refresher and remediation
Standardization (3)
Reduces student-to-equipment ratio
Great for remedial training
Broad student availability
EIDS Arm[illegible] standardization
Permits unlimited practice

Weaknesses

Time to develop (3)
Cost (3)
Manpower
Limited branching by developers
More computers needed
Software glitches
Dedicated simulations will not run on micros
Needs expert system branching
Real equipment does not have training software

* Unless specified, these comments refer to IVD

Appendix D

Training Technology Fact Sheets

search technology, inc.

systems engineering approaches to research and development

Training Technology Fact Sheets:

An Interim Product of the

Training Technology Review at the

U.S. Army Signal Center and Fort Gordon

Prepared for

U.S. Army Research Institute
Fort Gordon Field Unit
Fort Gordon, Georgia 30905-5000

Under subcontract to

The Allen Corporation of America
209 Madison Street
Alexandria, Virginia 22314

Prepared by

William B. Johnson, Ph.D.
Search Technology, Inc.
4725 Peachtree Corners Circle
Norcross, Georgia 30092

Abstract

The Army Research Institute Field Unit at the U.S. Army Signal Center and Fort Gordon has conducted a brief review of new training technology in place, or planned, at the Signal School. In addition, the study identified other training technology that may be of value for Army electronics training. The training technology fact sheets present example research, applications, and/or training technology review.

The author does not suggest that the list here is all inclusive of new training technology.

Training Technology Fact Sheet Index

Introduction

As a part of the Training Technology Review conducted at Fort Gordon, numerous systems were identified and briefly reviewed. The systems presented in the fact sheets are a mixture of research and application. For the most part, the systems identified have demonstrated direct applicability to electronics training. Many of the systems were identified and reviewed because of a specific request from Signal School personnel.

Format of Fact Sheets

The format of the fact sheets was designed to be useful to Signal School managers and staff. The format of the fact sheets was reviewed by Signal School personnel early in the project. The fact sheets are not meant to be a scientific treatment of the system but instead have a practical viewpoint. For that reason, telephone numbers of developers and sponsors have been included whenever possible. In most cases, references to additional information is included.

AIR
PERI-ICD
Fort Gordon, GA 30905

TRAINING TECHNOLOGY FACT SHEET

System Name: Basic Electronics Maintenance Trainer (BEMT)

Description:

This is a new electronics training delivery system that will use IVD, CBI, and an NIDA 13OC trainer with associated test equipment.

Type of Training: Basic electronics training. The plan is to include all the core units for a BET course.

Target Population:

Level 10 training for students in intelligence electronics.

Development/Completion Dates:

Originally scheduled for completion in November of 1988. Contractor went out of business. New delivery schedule is planned for June 1990.

Current Status and Future Plans: In development (major contractual problems)

Training Features:

Videodisc
Computer-based Instruction
Interfaced to NIDA 13OC Trainer
Networked (220 Stations)
Authoring System Available

Relative Complexity of System Development:

New development comparable to typical IVD/CBI effort. Interface to NIDA 130 and to test equipment makes development slightly more complicated.

Development/Modification by Signal School:

Signal School would need BEMT hardware. Don't expect BEMT to transition easily to other systems like EIDS.

Hardware/Software:

Dedicated BEMT training system. Includes mini-computer, network, and student stations. Student stations to include IBM PC/XT compatible computer, Pioneer Laser Videodisc, high resolution monitor, NIDA 130 Test Console, and a Tektronix multifunction tester. Authoring system uses VISION package which will change since company went out of business.

Evaluation Data: None at this time.

Notable Advantages/Disadvantages:

It appears that the system will provide comprehensive basic electronics training. However, the disadvantage is the delayed delivery to 1990. There is a distinct possibility that the system, which began in 1985, will have old technology when it is delivered in 1990.

Portability to EIDS:

Not directly portable to EIDS. Additional hardware will be necessary due to interface with NIDA 130C trainer.

Developer/Sponsor:

Developer: Original contractor out of business
New RFP in process

Sponsor: Mr. Peter York
Contracting Engineer
NTSC
Orlando, Florida
(407) 380-4748

References: N/A

ARI
PERI-ICD
Fort Gordon, GA 30905

TRAINING TECHNOLOGY FACT SHEET

System Name: Electronic Information Delivery System (EIDS)

Description:

The U.S. Army standard hardware/software system for development and delivery of interactive audio/visual training.

Type of Training: Any domain.

Target Population: Any level.

Development/Completion Dates:

EIDS systems first delivered in late 1987. The TRADOC inventory of EIDS equipment will increase to xxx units.

Current Status and Future Plans:

EIDS is likely to remain as the Army standard for the foreseeable future.

Training Features:

MS-DOS compatible CBI
EIDS Assist Authoring
IVD

Relative Complexity of System Development:

The authoring system makes CBI/IVD development reasonably straightforward.

Development/Modification by Signal School:

EIDS systems are already in place at the Signal School. The development "know how" is already in place at the Signal School.

Hardware/Software:

EIDS represents a technology that has been evaluated in numerous training applications.

EIDS compatible	Overlay graphics and videodisc
MS-DOS release 3.2 operating system	Sound-over-still
PC AT hardware- and software-compatible	Extended EGA/VGA graphics: 720 x 480
Dual 1.4 Megabyte floppies	Digital compressed audio
20, 40, or 80M byte SCSI hard disk	Keyboard, mouse, touch-screen, joystick, trackball, keypad, table input device support
1.8G byte hybrid videodisc standard	RGB or NTSC single-monitor display

Evaluation Data:

EIDS represents a technology that has been evaluated in numerous training applications

Notable Advantages/Disadvantages:

Advantage: Army standard

No obvious disadvantages as an IVD/CBI delivery system. Some researchers might say it has limited AI capacity.

Portability to EIDS: N/A

Developer/Sponsor:

Developer: Matrox Electronic Systems, Ltd.
1055 Saint Regis Boulevard Dorval
Quebec, Canada H9P 2T4
(514) 685-2630

Sponsor: N/A

References: N/A

ARI
PERI-ICD
Fort Gordon, GA 30905

TRAINING TECHNOLOGY FACT SHEET

System Name: Generalized Maintenance Training System (GMTS)

Description:

An interactive video system used by the Navy. The system was designed to permit the user to simulate system operation and diagnosis using videodisc photos.

Type of Training:

Was used for radar training and one ship gun system. Also used for bladefold training on SH-3 helicopter.

Target Population:

Navy students in C-level schools on specific hardware systems.

Development/Completion Dates:

Evolved from late 1970's through mid-1980's. No new systems have been developed since 1984.

Current Status and Future Plans:

The GMTS videodisc system is no longer being used to develop or deliver new interactive video. The GMTS system, much like other IVD, provided little instruction or tutorial feedback. The students became bored with the system's simplistic, linear approach to training.

Remnants of GMTS are still used in a Navy gatling gun trainer and in portions of the IMTS for SH3 helicopter bladefold training.

Training Features:

Interactive video to simulate system operation.

Relative Complexity of System Development:

Comparable to other IVD development. In addition, it was necessary to build a matrix, with photos, of the system in various states of operation and failure.

Development/Modification by Signal School:

Not likely to be used by Signal School. Software and development approach is not as good as the EIDS available to the Signal School.

Hardware/Software:

Used a variety of dedicated microcomputers and videodisc players that evolved during the late 1970's and early 1980's.

Evaluation Data:

The system was evaluated numerous times in Naval training applications.

Notable Advantages/Disadvantages:

The system was at the cutting edge of IVD development in the late 1970's. At this point in time, the GMTS hardware, software, and development system has been replaced by systems like EIDS.

Portability to EIDS: N/A

Developer/Sponsor:

Developer: University of Southern California
and then the Cubic Corporation

Sponsor: U.S. Navy Personnel Research and Development System

References:

Towne, Douglas M. (1987). The generalized maintenance trainer: Evolution and revolution. In W.B. Rouse (Ed.), *Advances in Man-machine Systems Research: Volume 3*, pp 1-63. Greenwich, CT: JAI Press, Inc.

ARI
PERI-ICD
Fort Gordon, GA 30905

TRAINING TECHNOLOGY FACT SHEET

System Name: IBM InfoWindows Courseware

Description:

IBM InfoWindows is a hardware and software system for development and delivery of CBI and IVD. The IBM development courseware includes the Learning System 1 (LS/1) and the InfoWindows Presentation System (IWPS).

There is not 100% compatibility between EIDS and InfoWindows.

Type of Training:

Broad application including electronics training.

Target Population: Many levels (see catalog)

Development/Completion Dates: Currently available.

Current Status and Future Plans:

Many titles already available. More in development by IBM and other courseware developers.

Training Features:

Same as EIDS. Contains development and delivery courseware.

Relative Complexity of System Development:

Same as other IVD/CBI development efforts.

Development/Modification by Signal School:

Same as EIDS.

Hardware/Software:

InfoWindows has a hardware configuration like EIDS. However, the systems are not compatible.

Evaluation Data:

Evaluation of many CBI/IVD applications apply to InfoWindow.

Notable Advantages/Disadvantages:

The advantages are the multitude of available courseware titles and the service infrastructure provided by IBM.

Portability to EIDS:

The systems are not compatible. However, developers of InfoWindows courseware can do reasonably priced conversions to EIDS.

Developer/Sponsor: Courseware catalog available from:

Developer: IBM
Marketing Support
Department 7EY
3301 Windy Ridge Parkway
Marietta, GA 30067

Attention: Edward Bickterman
(404) 988-2249

Sponsor: N/A

References: N/A

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TRAINING TECHNOLOGY FACT SHEET

System Name: The Intelligent Maintenance Training System (IMTS)

Description:

IMTS is a research project near completion. The system permits the user to interact with a simulation for diagnostic practice and training.. The system creates a model of the student by recording such things as actions, mistakes, number of problems solved, difficulty of problems solved, time to solution, etc. Based on student performance IMTS provides intelligent feedback comparable to a human tutor. In its current version, it is interfaced to the Generic Maintenance Training System, which is a video disk-based simulation system.

Type of Training:

The current system is designed for electrical and mechanical diagnosis of the rotor system on the SH-3 Navy helicopter. Another system is being developed for a shipboard radar system.

Target Population:

The first development was for aviation metalsmiths and electricians at the school at North Island Naval Air Station in San Diego. The technology appears to be transferable to a variety of domains and student ability levels.

Development/Completion Dates:

1985 - Present. The IMTS research is in progress. Minor user acceptance studies have taken place at the North Island Naval Air Station Flight Mechanic School in San Diego.

Current Status and Future Plans:

The second application is for the Whisky 3 shipboard radar system training. This development is testing the usability of the authoring system that was developed in the first phase of the project. Developers expect IMTS to undergo change during this second effort.

Training Features:

IMTS is a student-controlled free play simulation with continuous tutoring. The system uses graphics and videodisc, however, the system does not require videodisc.

Relative Complexity of System Development:

IMTS software development has been in progress since 1984. The system complexity is very high. The level of effort to develop a knowledge base in a new technical domain would exceed one person-year. Eventually IMTS will have a stand alone authoring system. However the current system requires the close participation of the original programmers and knowledge engineers.

Development/Modification by Signal School:

Development and/or modification is difficult at this time Until the Signal School can dedicate a team of 2-3 full-time personnel, including a LISP programmer, to such development IMTS would not be a useful system. IMTS requires a Xerox 1186 workstation , not EIDS compatible, which is another reason it should not be considered for the Signal School.

Hardware/Software:

The IMTS requires dedicated hybrid computing systems. The intelligent tutoring software is written in Lisp on a Xerox 1186 workstation, equipped with optional memory and storage. The 1186 is interfaced to the Navy GMTS workstation, which is a microcomputer and videodisc system. All screens are equipped with a touch panel.

Evaluation Data:

None available at this time.

Notable Advantages/Disadvantages:

The IMTS includes an authoring environment to build additional simulation and training delivery systems. The authoring system is extremely robust, therefore, complex. No systems have been built outside the laboratory of the developer.

IMTS is, perhaps, the most sophisticated of all the intelligent tutoring systems in existence today. However, the IMTS is very complicated for the instructional developer and for the student user. Current efforts are aimed at simplification of the development and delivery system.

Perhaps the major disadvantage of IMTS is the hardware. The Xerox 1186 is expensive and temperamental. It is not designed as a training delivery system.

Portability to EIDS:

The task of porting IMTS to EIDS would not be possible. IMTS requires a high power dedicated AI workstation.

However, the idea of using EIDS hardware to interface a simulation-based intelligent tutoring system to an interactive videodisc is a good one. The design of IMTS should not be ignored for research related to intelligent and interactive videodisc.

Developer/Sponsor:

The IMTS was developed by the University of Southern California Behavioral Research Laboratory in conjunction with Search Technology of Atlanta, GA. The research is sponsored by the Office of Naval Research and the Navy Personnel Research and Development Center.

Developer:	Dr. Douglas Towne Behavioral Technology Laboratory 1845 South Elena Avenue Redondo Beach, CA 90277 213-540-3654	
Sponsor:	Dr. Susan Chipman ONR Washington, DC 202-696-4318	Capt. Vern Malec, USN NPRDC San Diego, CA 619-553-7694

References:

Towne, Douglas M., Munro, Allen, Pizzini, Quentin A., Surmon, David S., and Wogulis, Jim (1988). *Intelligent Maintenance Training Technology: ONR Final Report* (TR No. 110). Los Angeles, CA: University of Souther California Behavioral Technology Laboratory.

Towne, Douglas M. (1987). The generalized maintenance trainer: Evolution and revolution. In W.B. Rouse (Ed.), *Advances in Man-Machine Systems Research, Vol. 3* (pp. 1-63). Greenwich, CT: JAI Press.

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TRAINING TECHNOLOGY FACT SHEET

System Name: MACH III

Description: Artificial Intelligence-based Training System

Type of Training:

Computer based simulation with extensive graphics. Contains intelligent tutoring for diagnostic training on the radar for the HAWK missile system.

Target Population:

Novice trainees for organizational maintenance level.
Trains 24C MOS.

Development/Completion Dates:

Development began in October 1985 with completion scheduled for October 1988. Contract extensions are likely in October.

Current Status and Future Plans:

System is in final stages of development/evaluation at Fort Bliss. The current system includes only the receiver and transmitter. Additional modules must be developed for remaining radar subsystems.

Training Features:

System is designed to emphasize the development within the 24C trainee of a useful mental model of the organization, function, and operation of the radar, through guided practice in simulated troubleshooting activities.

Relative Complexity of System Development:

Very complex development. Would require extensive interaction with contractor personnel.

Development/Modification by Signal School:

Could not be done by Signal School personnel.

Hardware/Software:

Symbolics AI workstation interfaced to Symbolics Hi-Resolution color monitor and to Symbolics monochrome display.

Evaluation Data:

Initial evaluation and implementation at U.S. Army Air Defense Artillery School, Fort Bliss, Texas. Extensive evaluation is scheduled for 1988-1989.

Notable Advantages/Disadvantages:

Advantage: A very sophisticated ITS with dynamic high resolution color displays. This is a "full blown" ITS.

Disadvantage: Three-year development effort was expensive. System is not fully completed for training application. System is on a dedicated AI workstation with hardware that is not likely to be available in abundance in Army schools.

Portability to EIDS:

Not portable to EIDS. The system complexity requires substantive computing power exceeding the EIDS capability.

Developer/Sponsor:

Developer: L. Dan Massey
BBN Laboratories
(617) 873-3515

Sponsor: Dr. Joseph Psotka
U.S. Army Research Institute
(202) 274-5540

References:

Massey, D., De Bruin, J., and Roberts, B. (1988). A training system for maintenance. In J. Psotka, L.D. Massey, and S.A. Mutter (Eds.), *Intelligent Tutoring Systems: Lessons Learned.* Hillsdale, NJ: Lawrence Erlbaum Associates (pp. 369-402).

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TRAINING TECHNOLOGY FACT SHEET

System Name: Maintainer's Associate Training Instructional Environment (MATIE)

Description:

MATIE is a research project designed to address two issues: development of an intelligent tutoring system based on a previously completed expert system, and development of a generic troubleshooting trainer. MATIE allows a student to perform troubleshooting on a functional diagram and receive coaching on inefficient testpoint selection.

Type of Training:

A troubleshooting trainer originally developed to train Air Force technicians to troubleshoot an F-111 6883 Avionics Teststand, MATIE has been made generic so that any system that can be depicted as a functional diagram can be used as the knowledge domain.

Target Population:

The current version has been designed for demonstration purposes only. Future versions will be focused toward relatively novice electronic technicians.

Development/Completion Dates:

1986 - Present. Future work is expected to begin by 1989.

Current Status and Future Plans:

Work on Phases I and II has been completed. Phase III would turn MATIE from a demonstration to a working system, and include evaluation of the system with students, novice electronic technicians.

Training Features:

MATIE is a student-controlled simulation that only coaches when the student makes systematic errors. A set of parameters specify the amount and frequency of coaching.

Relative Complexity of System Development:

The development of the system to date was very complex. Development of new knowledge bases, however, is very easy. The current demonstration system allows development of a new knowledge base by a programmer in a few hours. Future systems will be developed so that a subject matter expert could custom design a knowledge base as quickly.

Development/Modification by Signal School:

MATIE will only be useful to the Signal School once it is made a student-ready system. Additional development would require a LISP programmer. Development and modification of new knowledge bases, however, would not require a programmer.

Hardware/Software:

MATIE is written in Xerox Interlisp-D. It was developed on a Xerox 1186 workstation, and will run on any hardware that runs Xerox Interlisp-D, including a Sun workstation.

Evaluation Date:

None available at this time, but the next phase of development should include collection of evaluation data from pilot students.

Notable Advantages/Disadvantages:

MATIE is a generic troubleshooting trainer that can be used with domains other than electronics. A knowledge base can be built from any system that can be represented as an information flow diagram with no feedback loops. New knowledge bases can be easily developed.

The major disadvantage of MATIE is that it runs in Interlisp-D, and requires a powerful and expensive workstation for both development and delivery.

Portability to EIDS:

The task of porting MATIE to EIDS would be an extremely difficult one. MATIE would need to be totally rewritten.

Developer/Sponsor:

Developer: Kent Jones
Allen Corporation of America
209 Madison Street
Alexandria, VA 22314
(703) 548-4200

Sponsor: LTC Hugh Burns
AFHRL/IDI
Brooks AFB, TX
(512) 536-2380

References:

Jones, K.R., Bamford, D.E., Richardson, J.J., & Sizer, T. (1987). *Maintainer's Associate Training Instructional Environment (MATIE) Final Report: Phase I.* Training Systems Division, U.S. Air Force Human Resources Laboratory. Brooks AFB, TX.

Jones, K.R., Richardson, J.J., & Tiene, K. (in press). *Maintainer's Associate Training Instructional Environment: ITS Demonstration (MATIE II).* Training Systems Division, U.S. Air Force Human Resources Laboratory. Brooks AFB, TX.

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TRAINING TECHNOLOGY FACT SHEET

System Name: Meteorological Data System Training System (MDS)

Description: Operator-Trainer - full fidelity simulators and CBT

Type of Training:

Operation, Unit Level Maintenance and Intermediate (Direct Support) Repair of the Meteorological Data System.

Uses simulation, computer-based training, and interactive videodisc.

All lessons include a demonstration, scored and unscored practice at increasing levels of complexity, a test and alternate tests.

Target Population:

Advanced Individual Training (AIT) students (10 level) of the Army and Marine Corps at the U.S. Army Field Artillery School, Ft. Sill, OK.

Development/Completion Dates:

Training requirements analysis study - October 1984 thru February 1985.

Development - Scheduled October 1985 thru August 1987
Development - Actual - November 1985 thru January 1988

Government acceptance - July 1988

Current Status and Future Plans:

Currently installed in O-SEE-O Hall, Ft. Sill, OK.

Training Features:

Operator Trainer: Three complete systems, each consisting of seven student stations and a dual instructor station.

Unit Level Maintenance Trainer: Nine student stations and a dual instructor station.

Intermediate Level Maintenance Trainer: Six student stations and a dual instructor station.

Relative Complexity of System Development:

Simulator

Complexity of the MDS and the procedures required to operate the MDS coupled with the detailed scoring and extensive CMI employed resulted in a highly complicated development effort. Interfacing an authoring language with contractor developed software that controlled/ polled a large number of simulator controls and displays further complicated the program. Integrating the new capabilities of several courseware releases and several specially developed courseware features added more complexity. Isolating problems to simulator hardware, interface panel hardware or software, courseware, operating system hardware or software was very difficult. Capabilities of the operating system were constantly being pushed to the limit.

CBT/IVD

Fairly straightforward CBT/IVD development effort. Limited freeplay multiplied complexity.

Development/Modification by Signal School:

Specific use of training system precludes use by the Signal School. Concepts and approaches employed in the training delivered with the simulator and the CBT apply to all shelter mounted electronic systems and would be of direct interest to the Signal School.

Hardware/Software:

Operating System

Software: Ford Aerospace MicroTICCIT System

Hardware: Data General S-280 CPU (2)
Operator Console 6 16BN (2)
Mag Tape Drive DG5 125 (2)
Disk Drive DG606 1H (2)
Graphics Digitizer System (1)
Versatec Printer (1)
LAN Gateways (2)
8-Port Hubs

Simulator Student Stations

Software: Allied Bendix developed software

Hardware: Mitsubushi Hi-Res Color Monitor (21)
TICCIT (modified IBM PC) Computer (21)

Modified TICCIT Keyboard (21)
Bendix developed Interface Board (21)
Simulator hardware (some items actual MDS hardware)

Operator Instructor Stations

Hardware: Mitsubushi Hi-Res Color Monitor (6)
TICCIT (modified IBM PC) Computer (6)
Standard TICCIT Keyboard (6)
Epson Dot Matrix Printer (3)

Maintenance Student Stations

Hardware: Sony Low-Res Color Monitor (15)
TICCIT (modified IBM PC) Computer (15)
Standard TICCIT Keyboard (15)
Light Pen (15)
Sony LDP Series Laserdisc Player (15)

Maintenance Instructor Stations

Hardware: Sony Low-Res Color Monitor (4)
TICCIT (modified IBM PC) Computer (4)
Light Pen (4)
Sony LDP Series Laserdisc Player (4)
Epson Dot Matrix Printer (2)

Evaluation Data:

System evaluated by U.S. Army Field Artillery School instructors during IKP Training at the Allied Bendix Environmental Systems Division during the period July thru October 1988. Comments resulting from this evaluation were incorporated in the training system where they had merit. The government performed final acceptance tests on the system when installed at Ft. Sill. The government accepted the system after a second (non-backup) disk drive was added to the system to increase system response time.

Notable Advantages/Disadvantages:

Advantages:

Simulator provides highly realistic procedures training. Multiple scenarios allow practice in diverse situations.

CBT allows non-destructive practice in troubleshooting and repair of the MDS and MDS components.

Automatic scoring and computer controlled progress reduces demands on instructors. Availability in real-time of class and individual student status allows instructors to provide help where most needed.

Immediate feedback and helps provide the students with highly interactive instruction.

Disadvantages:

Long development time.

Cost.

Difficult to isolate/correct problems.

Requires highly trained personnel for courseware maintenance.

System response time can be slow when the system is fully loaded.

Portability to EIDS:

Some efforts to examine the feasibility of translating MicroTICCIT courseware to EIDS have been conducted - results unknown. MicroTICCIT is a very powerful and big authoring system that requires unique commands to carry out each function. It is unlikely that MicroTICCIT can be economically transferred to EIDS or any other system.

Developer/Sponsor:

Developer: Mr. T. Herndon
Allied Bendix Corporation
Environmental Systems Division
1400 Taylor Avenue
Baltimore, MD 21284-9840

Mr. A.J. Ryan, III
Allen Corporation of America
209 Madison Street
Alexandria, VA 22314

Sponsor: Mr. J. Schulman
EW/RSTA Center
Attn: AMSEL-EW-MD
Fort Monmouth, NJ 07703

Target Acquisition Department
U.S. Army Field Artillery School
Fort Sill, OK

References: N/A

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TRAINING TECHNOLOGY FACT SHEET

System Name: Microcomputer Intelligence for Technical Training (MITT)

Description: An intelligent tutoring system based on computer simulation. The primary information is displayed with low resolution color graphics.

Type of Training: First application was for NASA Space Shuttle fuel cell diagnostic training.

Target Population:

First application was for astronauts and flight control engineers.
Concept is applicable to any diagnostic training for a variety of skill levels.

Development/Completion Dates:

First application started July 1987 and was completed January 1988. MITT is a product of diagnostic training R&D conducted by Johnson, Hunt, and Rouse since 1976. Related training products are TASK, FAULT, SB3614 Simulation, DGSIM, and others (see references).

Current Status and Future Plans:

First system in place at NASA Johnson Space Center is used mostly for ITS demonstration and limited instructional use. Second system, to be developed in fiscal 1989, will be used for actual training. An authoring system will be built in 1989-1990 by Search Technology under contract to the U.S. Air Force Human Resources Laboratory, Brooks AFB.

Training Features:

Provides graphic depiction of critical space shuttle instruments to permit user to collect information for troubleshooting.

Provides feedback that is specific to the user's understanding of the system.

Permits free play diagnostic practice with computer tutoring.

Relative Complexity of System Development:

Fuel cell knowledge base development required approximately 2-person months.

Development/Modification by Signal School:

The authoring system will permit Signal School personnel to develop additional systems. Contractor support for first development is recommended, but not absolutely required.

Hardware/Software:

IBM-AT class computer with 640Kb RAM and harddisk. CGA graphics card and color monitor. System written in C and expert system shell CLIPS.

Evaluation Data:

System received NASA acceptance tests by contractor and by Air Force Human Resources Laboratory. System was favorably accepted by students and instructors. In 1989, system will be modified based on results of the evaluations.

Notable Advantages/Disadvantages:

Advantages: Rapid development
Wide range of diagnostic options for student
Low development costs
Provides intelligent tutoring
Operates on IBM/AT and compatible equipment including EIDS.

Disadvantages: Limited to CGA graphics capability in first NASA application.

Portability to EIDS:

Will run on EIDS without any modification

Developer/Sponsor:

Developer: Dr. William B. Johnson
Search Technology, Inc.
4725 Peachtree Corners Circle
Norcross, GA 30092 (404) 441-1457

Sponsor: Lt. Col. Hugh Burns
U.S. Air Force Human Resources Laboratory/IDI
Brooks AFB, TX 78235 (512) 536-2981

References:

Johnson, W.B. (in press). Intelligent tutoring systems: If they are such good ideas, why aren't there more of them? *Proceedings of the Tenth Annual Interservice Industry Training Systems Conference*. Orlando, FL: November 1988.

Johnson, W.B., Norton, J.E., and Duncan, P.E. (1988). An intelligent tutoring system for space shuttle diagnosis. *Proceedings of the Conference on Space Operations Automation and Robotics.* Dayton, OH: The United States Air Force and the National Aeronautics and Space Administration.

Johnson, W.B. (1988). Pragmatic considerations in development and implementation of intelligent tutoring systems. In M.C. Polson and J.R. Richardson (Eds.), *Foundations of intelligent tutoring systems*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc. (pp. 189-205).

Johnson, W.B. (1988). Developing expert system knowledge bases for technical training. In L.D. Massey, J. Psotka, and S.A. Mutter (Eds.), *Intelligent Tutoring Systems: Lessons Learned*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc. (pp. 21-33).

Johnson, W.B., Norton, J.E., Duncan, P.C., and Hunt, R.M. (1988). Development and demonstration of microcomputer intelligence for technical training (MITT) (AFHRL-TP-88-8) Brooks AFB, TX: Air Force Human Resources Laboratory.

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TRAINING TECHNOLOGY FACT SHEET

System Name: Qualitative Understanding of Electrical System Troubleshooting (Quest)

Description:

An intelligent tutoring system research program. The emphasis is on training students to learn electronics by creating their own internal understanding (mental model) of circuits rather than relying on quantitative models (like Ohm's Law, Kirchoff's Law, etc.). The Quest system permits student to learn about electronics by interacting with a dynamic simulation of circuit behavior.

Type of Training: Initial research is with basic electronics.

Target Population: Technical training in electronics.

Development/Completion Dates: 1983 - on going

Current Status and Future Plans:

BBN is also developing a tutor for training operator/maintainers of a complex automatic avionics test station for the Air Force.

Training Features:

Like other ITSs, QUEST creates an evolving model of the student's understanding of basic circuits and then presents problems of appropriate difficulty. If a student cannot solve a problem, the ITS will show them how and provide explanation as needed. The Quest system permits students to build and test circuits.

Relative Complexity of System Development:

System development is complex.

Development/Modification by Signal School:

System is not available as a training product. Development/modification must be done in cooperation with BBN research team.

Hardware/Software:

The Quest software exists on a dedicated Xerox 1186 AI workstation. It is written in InterLisp D.

Evaluation Data:

Initial evaluations have been with high school physics students.

Notable Advantages/Disadvantages:

The advantage is that the system has robust methods to model the student and to explain the instructional domain of electronics. A very bright research team has worked on the system for nearly 5 years.

The disadvantage is that the system is a research effort existing on a computer system not available in quantity at the Signal School. The transition from the research environment to the operational training environment would not be straightforward.

The Signal School, however, would be an ideal environment to evaluate the Quest system for basic electronics training.

Portability to EIDS:

Not transportable to EIDS. Computing requirements for Quest exceed the capability of a microcomputer.

Developer/Sponsor:

Developer: Dr. Barbara Y. White
Dr. John R. Frederiksen
BBN Laboratories
10 Moulton Street
Cambridge, MA 02238

Sponsor: Office of Naval Research, The Army Research Institute, and The Air Force Human Resources Laboratory

References:

White, B.Y., & Frederiksen, J.R. (1987). Qualitative models and intelligent learning environments. In R.W. Lawler and M. Yazdani (Eds.), *Artificial intelligence and education* (pp. 281-205). Norwood, NJ: Ablex Publishing.

Feurzeig, W., & Ritter, F. (1988). Understanding reflective problem solving. In J. Psotka, L.D. Massey, and S.A. Mutter (Eds.), *Intelligent tutoring systems: Lessons Learned*, (pp. 435-450). Hillsdale, NJ: Lawrence Erlbaum Publishers.

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TRAINING TECHNOLOGY FACT SHEET

System Name: Satcom Knowledge Intelligent Learning System (SKILS)

Description:

SKILS is a demonstration developed by SFC Dale White, in the Electronics Maintenance Department at Fort Gordon. It is primarily computer based testing (CBT) with expert system intelligence developed within the M.1 environment. It is a product of Sergeant White's participation in the Signal School's Expert System course.

While White's SKILS is not yet completed, he has demonstrated how a networked PC lab, in Vincent Hall, can deliver instruction and provide training.

Type of Training: Computer based testing

Target Population: Satellite Communications Students

Development/Completion Dates:

Demonstration developed during 1988, completion hinges on the availability of personnel.

Current Status and Future Plans:

See above

Training Features:

Provides computer based testing in a PC lab with 30 student stations. The lab has been networked so that users can access a variety of training software from the main file user

Relative Complexity of System Development:

Low complexity but useful training/testing approach.

Development/Modification by Signal School:

This was developed, entirely, by the Signal School.

Hardware/Software:

IBM PC/XT class machines. The network is part of the NIDA 130C training system.

Evaluation Data:

None at this time.

Notable Advantages/Disadvantages:

Good example of "home-grown" software and use of PC network to deliver instruction as well as testing.

Portability to EIDS:

Will transfer directly to EIDS.

Developer/Sponsor:

Developer: SFC Dale White
791-7524

Sponsor: Signal School
Electronics Maintenance Department
Vincent Hall

References: N/A

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TRAINING TECHNOLOGY FACT SHEET

System Name: SIMNET

Description:

A large network of Army simulators including tanks and helicopters. Permits practice battle fighting involving up to 1500 soldiers at numerous locations in U.S. and Europe.

Type of Training: Tactical Warfare Simulation

Target Population:

Tank operators and/or commanders. Helicopters and A-10 aircraft also linked to SIMNET.

Development/Completion Dates:

Research began in 1983. Demonstration systems currently in place.

Current Status and Future Plans:

Full scale delivery systems in numerous locations by 1991.

Training Features:

Permits full-scale battle decision making. Tank and aircraft simulators are networked to interact with each other.

Relative Complexity of System Development:

Very complex.

Development/Modification by Signal School:

TRADOC would have to direct that a similar simulator network be developed for communications.

Hardware/Software:

Simulator microprocessors and minicomputers for networking.

Evaluation Data:

User acceptance of specific simulation is very positive. The SIMNET concept is also well received by trainers, managers, and students.

Notable Advantages/Disadvantages:

The primary advantage is that SIMNET permits numerous simulator sites to network for simulated battle engagement.

Portability to EIDS:

At this time, portability to EIDS is not a SIMNET issue. It links simulators rather than EIDS-like systems. However, the SIMNET kind of linking of EIDS for a communications simulation is a concept worthy of consideration.

Developer/Sponsor:

Developer: Perceptronics and BNN under contract to:

Sponsor: Lt. Col. Jack T. Thorpe, USAF
Defense Advance Research Projects Agency (DARPA)
SIMNET Washington Office
1911 N. Fort Myer Drive, Suite 707
Arlington, VA 22209-1603
(703) 528-8903

Sponsorship is shared by DARPA, Army, and Air Force

References:

A set of SIMNET references is available by telephone request to office of Dr. Neal Cosby (703) 528-8903.

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TRAINING TECHNOLOGY FACT SHEET

System Name: Sophisticated Instructional Environment (SOPHIE I, II, and III)

Description:

The SOPHIE research centered on how the computer can quantify (i.e., model) student understanding of an instructional domain and provide explanation accordingly. The SOPHIE system was a research project. There is no training system available.

Type of Training:

Basic electronics was the instructional domain of the SOPHIE research.

Target Population: Novice electronics students

Development/Completion Dates:

The SOPHIE research spanned the years 1978-1983. While similar research continues, the SOPHIE name is no longer used.

Current Status and Future Plans: SOPHIE doesn't exist as a training system.

Training Features:

The SOPHIE system presented training in basic electrical circuits. The student modeling and explanation features were forerunners to today's intelligent tutoring system.

Relative Complexity of System Development:

Very complex long term research effort which helped pave the way for today's ITS.

Development/Modification by Signal School:

Only the SOPHIE concepts may be of value to the Signal School.

Hardware/Software: Xerox AI workstations, written in LISP

Evaluation Data: N/A

Notable Advantages/Disadvantages:

The advantage is that SOPHIE provided excellent basic research for intelligent tutoring systems.

The disadvantage is that SOPHIE was never intended to be a delivery system. It was basic research.

Portability to EIDS: SOPHIE is not portable to EIDS.

Developer/Sponsor:

Developer: John Seely Brown
Richard R. Burton
Xerox Palo Alto Research Center
3333 Coyote Hill Road
Palo Alto, CA 94304
(415) 494-4357

Sponsor: Sponsored by various DoD entities over the years including Air Force, Army, and Navy. ARI was a major sponsoring agency.

References:

Brown, J.S., and Burton, R.R. (1987). Reactive learning environments for teaching electronic troubleshooting. In W.B. Rouse (Ed.), *Advances in man-machine systems research - Volume 3.* Greenwich, CN; JAI Press, (pp. 65-98).

Brown, J.S., Burton, R.R., and de Kleer, J. (1982). Pedagogical, natural language and knowledge engineering techniques in SOPHIE, I, II, and III. In D. Sleeman and J.S. Brown (Eds.), *Intelligent Tutoring Systems.* New York, NY: Academic Press.

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TRAINING TECHNOLOGY FACT SHEET

System Name: STEAMER

Description:

One of the early expert systems for training. The research explored issues related to how people understand complex systems and how to display information to enhance that understanding.

Tools to development intelligent graphical interfaces were developed for laboratory use.

Type of Training: Steam propulsion system for Navy ships

Target Population:

Surface Watch Officers Course

Training for junior officers to understand operation and diagnosis of the ship's steamplant.

Development/Completion Dates: 1980 - Present (low effort)

Current Status and Future Plans:

There is some discussion of transporting the code from the Symbolics AI Workstation to a microcomputer. However, the 1200psi steam propulsion system is being phased out of the fleet, thus minimizing the likelihood that this will happen. The STEAMER research was on the "cutting edge" for a long time, but perhaps it now will become a part of ITS history.

Training Features:

Extensive graphical interfaces to control a complex dynamics simulation.

Relative Complexity of System Development:

System development was very complex.

Development/Modification by Signal School:

Not possible.

Hardware/Software: Symbolics AI Workstation

Evaluation Data:

The system, as a research product, was favorably received by the operations, training, and scientific communities.

Notable Advantages/Disadvantages:

The primary advantage is that the trainee could use Steamer to operate and troubleshoot the system by interacting with the dynamic simulation of the ship's steamplant.

Portability to EIDS:

Not portable to EIDS

Developer/Sponsor:

Developer: James D. Hollan (now with MCC in Austin, Texas)
Edwin L. Hutchins
Louis Weitzman
Navy Personnel Research & Development Center
San Diego, CA 92152

Sponsor: Navy Personnel Research and Development Center
San Diego, CA 92152

References:

Hollan, J.D., Hutchins, E.L., and Weitzman, L. (1984). STEAMER: An interactive inspectable simulation-based training system. *The AI Magazine, 5*(2), pp. 15-27.

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TRAINING TECHNOLOGY FACT SHEET

System Name: TICCIT (A development and delivery system)

Description:

The TICCIT system is a CBI/IVD delivery system that is applicable to an infinite number of instructional domains. The system exists as a mainframe system in its older configuration or, in current form, as a microcomputer system. Courseware developed on the older system, in most cases, will download to the newer MicroTICCIT systems. MicroTICCIT courseware will not run on the older mainframe TICCIT.

Type of Training:

Used in a variety of instructional applications. U.S. Marines are using TICCIT for communications electronics at 29 Palms, California. The Marines have 247 student workstations using the older mainframe TICCIT. The courseware for this system is comprised of text and limited graphics. The Marines have just acquired 39 MicroTICCIT stations which will eventually phase out the mainframe system.

Target Population:

Any level. One example is the Communications Officer "War Games" simulation used at 29 Palms.

Development/Completion Dates:

TICCIT is available as a commercial product from the Ford Aerospace Company. The older systems ran on a Hazeltine Mainframe. Current applications are all microcomputer oriented.

Current Status and Future Plans:

Currently, the MicroTICCIT system requires some dedicated TICCIT hardware. A planned version will stand alone on IBM AT Class computers and will be fully compatible with the EIDS system.

Training Features:

CBI, high resolution color graphics, and interactive videodisc.
Relative Complexity of System Development:

Comparable to other CBI/IVD projects. TICCIT authoring tools are among the best available.

Development/Modification by Signal School:

With the TICCIT system Signal School personnel, with IVD experience, can develop new systems.

Hardware/Software:

Dedicated TICCIT hardware and software.

Evaluation Data:

Numerous studies have shown that TICCIT, and systems like TICCIT, can be used to develop effective computer-based instruction.

Notable Advantages/Disadvantages:

TICCIT has evolved for nearly ten years. The authoring and delivery system is excellent.

Portability to EIDS:

The new TICCIT system will be EIDS-compatible.

Developer/Sponsor:

Developer: Ford Aerospace Company
Gerald Moore, Manager of Military Programs
10800 Parkridge Boulevard
Reston, VA 22091 (703) 620-6806

Marine Corps Communication Electronics School
Col. Juarez - CO
29 Palms, CA (619) 368-6176

Mr. Hillhouse - Chief, Courseware Development
29 Palms, CA (619) 368-7341

Mark Muller
Ford Aerospace/TICCIT
29 Palms, CA (619) 368-3337

Appendix E

Workshop Agenda

TRAINING TECHNOLOGY REVIEW

November 1988

Vincent Hall

8:30-8:45	Introduction	M. Sanders
Question 1:	Where is the Signal School with respect to new Training Technology?	
8:45-9:15	Research Method Definition of Terms Signal School Status	W. Johnson
Question 2:	What are the new Training Technology options for the Signal School?	
9:15-9:30	Training Technology Fact Sheets	W. Johnson
9:30-10:00	Intelligent Tutoring Systems	W. Johnson
	Comments by:	J. Frederiksen K. Jones D. White
10:00-10:20	Coffee Break	
10:20-11:00	Qualitative Understanding of Electronic System Troubleshooting (QUEST)	J. Frederiksen
11:00-11:20	Maintainer's Associate Training Instructional Environment (MATIE)	K. Jones
11:20-11:40	Satcom Knowledge Intelligent Learning System (SKILS) & Satcom Principles Network	D. White

11:40-12:00	Microcomputer Intelligence for Technical Training (MITT)	W. Johnson
12:00-1:00	Lunch	
1:00-1:30	Demonstrations MATIE, MITT, SKILS	
1:30-2:00	The Air Force Job Family of Tutors	J. Frederiksen
2:00-2:30	What Is Difficult About Building ITSs	Discussion by the Experts
	Diagnosing Student Understanding	K. Jones
	Selecting and Using Expert System Shells	D. White
	Capturing Evolution of Expertise in a Generative Form	
	Supporting Mixed Initiative Problem Solving	J. Frederiksen
	Comments (*Time Permitting*)	W. Johnson

Question 3: What steps must the Signal School take to make progress in regard to new Training Technology?

2:30-3:00	Current Plans for New Technology at Fort Gordon	W. Tomlinson
3:00-3:15	Coffee/Cokes	
3:15-3:55	How Should the Signal School Proceed	
	Selecting ITS Candidates	W. Johnson
	Planning/Discussion	All
3:55-4:00	Closing Remarks	M. Sanders
4:00-4:30	Repeated Demonstrations (*Optional*)	W. Johnson K. Jones D. White

PRESENTERS/DISCUSSANTS

Dr. John R. Frederiksen
Senior Scientist
BBN Laboratories, Inc.
10 Moulton Street
Cambridge, MA 02238
(617) 873-3468

Dr. William B. Johnson
Principal Scientist
Search Technology, Inc.
4725 Peachtree Corners Circle
(404) 441-1457

Mr. Kent R. Jones
AI Program Manager
The Allen Corporation of America
209 Madison Street
Alexandria, VA 22314

Dr. Michael Sanders
Army Research Institute
PERI-ICD Building 41203
Augusta, GA 30905
(404) 791-5523

Mr. William Tomlinson
New Systems Training Division
Fort Gordon, GA 30905

SFC Dale White
SATCOM Course
Electronic Maintenance Dept.
Fort Gordon, GA 30905
(404) 791-7524

Appendix F

LIST OF ACRONYMS

ARI	Army Research Institute for the Behavioral and Social Sciences
ATC	Air Force Air Training Command
BEE	Navy Basic Electricity and Electronics Course
CBI	Computer-based Instruction
CD-ROM	Compact Disc Read Only Memory
CMI	Computer-managed Instruction
EIDS	Electronic Information Delivery System
HRL	Air Force Human Resources Laboratory
ITS	Intelligent Tutoring System
IVD	Interactive Video Disc
NPRDC	Navy Personnel Research and Development Center
School	U.S. Army Signal School and Fort Gordon
R&D	Research and Development
TTFS	Training Technology Fact Sheets
TTR	Training Technology Review
WORM	Write-Once Optional Recording Media